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SUPPORTING STATEMENT FOR COMMUNITY STUDY OF HUMAN RESPONSE TO AIRCRAFT NOISE

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TABLE OF CONTENTS

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SUMMARY

A joint NASA/FAA study to quantify human response to aircraft noise has been designed. The objective of this study is to quantify the relationships between annoyance and the noise level of individual and aggregated aircraft flyover events. The information is needed to accurately predict and assess the noise impact of aircraft/airport operations and to define alternate aircraft operating procedures and land-use strategies which will result in the greatest reduction in noise impact achievable with a given noise abatement resource budget. The purpose of this technical memorandum is to describe the research program for organizations having an interest in the objectives, methods, and schedules to be employed in this study.

JUSTIFICATION

The effective control or reduction of noise impact requires an accurate understanding of the human response to the noise sources in question. The required human response information for most decisionmaking takes the form of a quantified "dose-response relationship" which is the relationship between the response of interest (annoyance, for example) and the magnitude of the noise. Considerable research is either underway or planned to develop such noise dose-response relationships for a wide range of applications. The EPA, for

example, has a legislative requirement resulting from the Noise Control Act of 1972, as amended by the Quiet Communities Act of 1978 (ref. 1) to:

> "Conduct or finance research including but not limited to investigation of the psychological and physiological effects of noise on humans--and the determination of dose/response relationships suitable for use in decision-making, with special emphasis on the nonauditory effects of noise."

With respect to aircraft noise, the Aviation Safety and Noise Abatement Act of 1979 (ref. 2) requires that the Secretary of Transportation through the FAA shall:

> (1) establish a single system of measuring noise, for which there is a highly reliable relationship between projected noise exposure and surveyed reactions of people to noise, to be uniformly applied in measuring the noise at airports and the areas surrounding such airports;
> (2) establish a single system for determining the exposure of individuals to noise which results from the operations of an airport and which includes, but is not limited to, noise intensity, duration, frequency, and time of occurrence; and
> (3) identify land uses which are normally compatible with various exposures of individuals to noise.

NASA and the FAA have responsibility for aircraft noise research and control with the emphasis of the NASA program being on research and the FAA program on noise regulation and policy. As part of this responsibility, the NASA and the FAA have developed a joint program to develop dose-response relationships for use in aircraft community noise reduction activities. The approach, as described herein, is to conduct a study in an airport community to quantify the dose-response relationship for individual and aggregated aircraft operations, and as a corollary, to assess the validity of various noise descriptors or metrics for quantifying the aircraft noise dose.

A quantified dose-response relationship developed specifically for aircraft operations is essential to the development of noise criteria for use in aircraft noise certification, noise abatement procedures, noise-impact

assessment, and land-use planning. These needs are addressed by this program.

In general, previous laboratory research has concentrated on the quantification of the noise dose (including spectral, tonal, duration, and number effects) and has resulted in metrics such as EPNL and NEF which are used in aircraft noise measurements. Community surveys on the other hand have examined community response to the relatively long term or integrated noise environment which is influenced by many situational and human factors as well as many non-aircraft noise sources such as road-traffic and industrial noise (ref. 3). Such survey data do not give detailed information on human response to aircraft specific issues such as aircraft type differences (general aviation, helicopter, and turbofan aircraft), time-of-day response differentials, and aircraft operating procedures.

The objective of the study described herein is to obtain dose-response relationships for aircraft operations in an airport community. The approach will consist of simultaneously measuring the subjective annoyance and noise of aircraft flights. The time of day, ambient noise level, aircraft type, aircraft operating condition, geographic location of airport, receiver location with respect to the flightpath, and other such acoustical and nonacoustical mediating factors will be examined in an effort to explain their influence on the dose-response relationship.

DESCRIPTION OF SURVEY PLAN

Airport Selection

In order to acquire data for a quantified dose-response relationship that can be generalized to various areas of the country, several airport communities

were selected for study; namely, St. Louis and Denver. The primary factors considered in selecting these airport communities for study were:

- o Adequate aircraft noise impacted residences
- o Sufficient aircraft movements per day
- o Variations in the density of aircraft movements per hour
- o Adequate mix or variety of aircraft types that enter the airport

Planning is underway for testing in these communities.

Sample Design

The sampling procedure used to obtain participants for the study is a stratified random sample. The design involves selecting residences, or test sites, rather than people. The sample universe includes the area within an airport's noise impact contour of L_{DN} = 65 dB. Within this noise contour, potential test areas will be defined according to easily identified physical (primary street) boundaries. The major stratification factor imposed on this sample design is the time of day of the test session.[1] A total of four different test times (0930-1130, 1330-1530, 1630-1930, and 2030-2230 hours) have been selected to represent this factor. The sample (equally divided between two airports; e.g., St. Louis and Denver) will include a total of 96 test sites (houses) of which 24 will be representative of each test time.

In order for a residence to become a test site, a minimum of four persons (with as many as three persons from the same city block) must be available and willing to participate in the test. Through random selection of a large number of test sites according to the sample design above, it is anticipated that data

[1]Annoyance response is assumed to be dependent upon the time of day and, therefore, a 10 dB penalty is generally applied to noise events occurring at night (ref. 4).

can be stratified according to various physical factors (geographical location of airport, ambient noise level, time of day, aircraft type, aircraft operational mode, and aircraft noise level) as well as any subjective factors of interest. Additional sampling (and testing) will be conducted if on-line data analysis reveals that certain strata are not adequately represented.

Site/Participant Selection

Test sites (single-family houses) will be selected at random from a list of candidate test sites within each test area. Three procedures will be used to secure participation of a resident. These procedures will include an invitation to participate through a:

- o Letter of invitation
- o Telephone contact
- o Onsite invitation

Once the cooperation of a resident has been secured, actual testing will depend upon obtaining the cooperation of a minimum of three additional participants (from the same house or city block), and all participants receiving audiograms (service supplied by research team). Each resident will be paid $50 for participation in the study.

Test Procedure

A typical day's testing will consist of collecting closely coupled physical aircraft noise and subjective response measures (described in successive subsections) at eight test sites. In order to collect data at these eight sites, two separate data acquisition teams will be used. The exact time of day for completion of testing at each test site, for each team, is outlined in Table I. Testing will be conducted an equal number of times for each time of day.

TABLE I.- DAILY TEST SCHEDULE

Activity	Measurement Times	
	Acquisition Team 1	Acquisition Team 2
Testing (Site 1)	Morning 0930-1130	Morning 0930-1130
Break	Lunch/Travel	Lunch/Travel
Testing (Site 2)	Afternoon 1330-1530	Afternoon 1330-1530
Break	Travel	Dinner/Travel
Testing (Site 3)	After/Eve. 1630-1830	After/Eve. 1730-1930
Break	Dinner/Travel	Travel
Testing (Site 4)	Evening 2030-2230	Evening 2030-2230

The basic amount of testing time for each test site is 2 hours. Note (Table I) that although this test period is constant for the two teams, the times do not overlap exactly. This staggering of test times is intended to maximize chances of collecting data (physical and subjective) during time periods of very heavy aircraft flyover activity. Each of the two data acquisition teams referred to in Table I is composed of two groups. One group is assigned to physical noise measurement and data recording and the other group solely to subjective measurement within the home. The responsibilities/ activities of each of these groups of a team are outlined in Table II.

TABLE II.- TWO-HOUR TEST SCHEDULE PER SITE

Time, Minutes		Measurement Group	
Continuous	Per Activity	Physical	Subjective
0- 15	15	Parking	Introduction to Resident
16- 30	15	Equipment Set Up/Cal.	Instructions to Participants
31- 90	60	Data Collection (Physical & Subj.)	Annoyance Response Assistance
91-110	20	Equipment Breakdown/Cal.	Administer Questionnaire
111-120	10	Determine Next Location/Route	Public Relation "Goodby"

Subjective tasks.- The two tasks (see Appendix) that participants/residents complete during testing are: (1) annoyance evaluations of aircraft noise for 60 minutes; the majority of people providing evaluations to single-event aircraft noise, and (2) a questionnaire that takes approximately 20 minutes to complete; one question involves a projection of annoyance to address time-of-day effects. In order to compare these test results with past community surveys, participants at selected test sites will be asked to base their evaluations on multiple-event sessions instead of single events. For these test sites, one-half of the subjects will be asked to provide single-event annoyance evaluations and the other half to provide multiple-event (1 hour) annoyance evaluations. By acquiring both single-event and multiple-event responses for the same aircraft noises, a single-to-multiple event transfer function can be developed as well as a comparison to community noise survey data which generally involve a long term (24 hours or greater) response.

Test length justification.- The activities of a participant during the 2-hour test period are outlined in Table II. This test period exceeds a duration of 1/2-hour in order to allow collection of information for the objectives provided in the justification section. If this test period duration is not allotted, the study would lack statistical validity due to: (1) insufficient amount of annoyance responses to provide representative stratifications for ambient noise level, aircraft type, and aircraft operating conditions, and (2) inadequate demographic type data collected with the questionnaire to precisely separate the effects of time of day and activities on annoyance to aircraft noise.

Data acquisition.- Subsequent to standard microphone calibrations, the following data will be recorded by the physical measurement group on an FM instrumentation tape recorder located in a small instrumentation van adjacent to each test site.

o One channel of outdoor sound pressure level: Measured with a 1/2-inch condenser microphone, located 45 inches from the ground surface, at a geometric location relative to the airport such that its position is not within a house noise shadow.

o Two channels of indoor sound pressure level: Both measured with 1/2-inch condenser microphones and located 45 inches from the floor surface; one microphone located in the geometric center of the test subjects and the second in the center of a remote room, preferably with one wall directly impacted by aircraft noise.

o Four channels of subjective annoyance response data: These data will be digitally encoded so as to reflect the degree of annoyance registered

by each of the four test participants to an aircraft event using the small hand-held response panels shown in figure 1.

- o One channel of time code.
- o One channel of aircraft identification information: A digital code will be used to record information as to the type and operational mode of each aircraft movement as determined by physical measurement personnel which are located outside of the test house.
- o One channel of voice annotation.
- o One channel to document recorder gain setting for a time period.

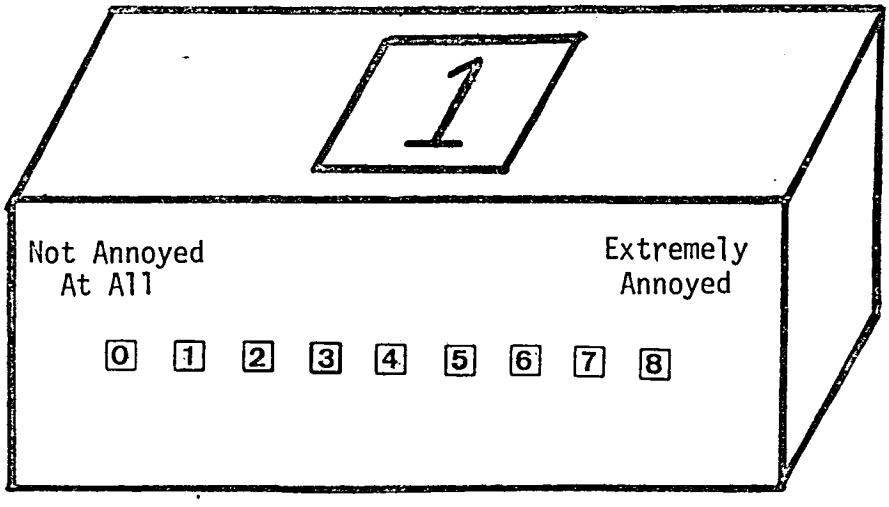


Figure 1.- Subjective response panel.

Data Reduction and Analyses

Data from selected flyovers will be analyzed in the test area on a daily basis to monitor data quality and to insure a balanced distribution of aircraft types, noise levels, and demographics. Data reduction and analysis

equipment will consist of a desk-top computer, a 1/3-octave band analyzer, an FM instrumentation tape recorder, a tape search unit, a thermal line printer, and a plotter. Dose-response relationships relating subjective response to noise level will be generated for various time of day, ambient noise levels, and flyover densities. These transfer functions will be constructed for a variety of noise metrics. The objective of this analysis will be to develop aircraft noise dose-response transfer functions and to determine how these functions depend on time of day, ambient noise level, flyover density, aircraft type, etc., and the metric used to characterize the noise exposure.

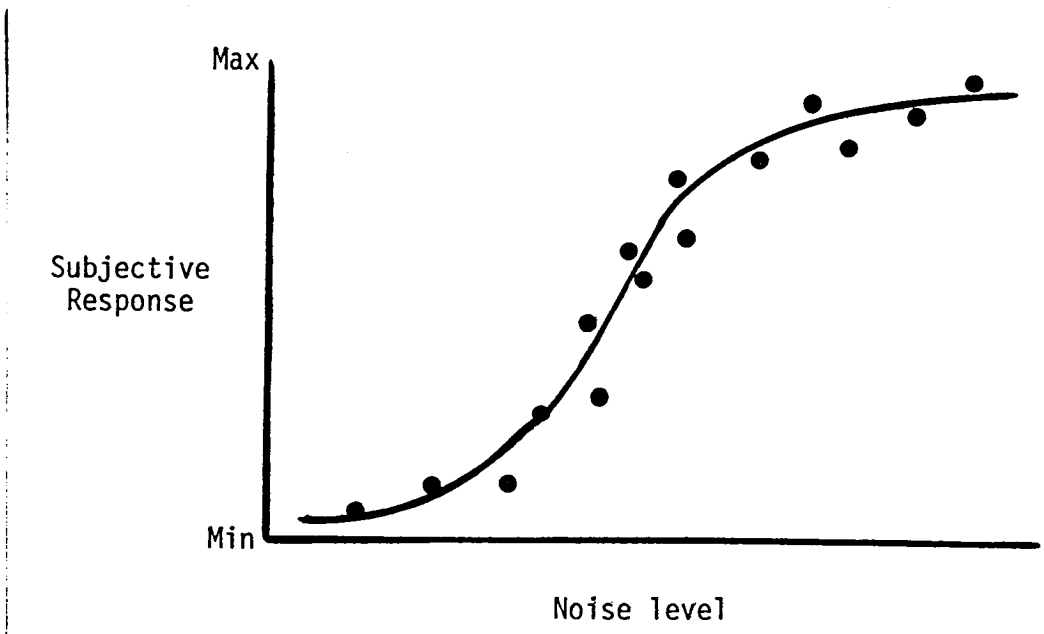


Figure 2.- Example of dose-response relationship.

To insure confidentiality of participant responses during the field test, security will be provided for completed questionnaires. This information will be stored in a secure location in file folders until it can be entered on magnetic tapes with corresponding annoyance ratings of a resident. At the time of constructing magnetic tapes, approximately 3 months after the field test,

participant names will be destroyed. Consequently, the method of retrieving information after that date will be restricted to statistical stratification summaries.

Pretesting

All the instrumentation to be used in this test program has been routinely used in previous field and laboratory studies. Therefore, "pretesting" (in an airport community in the Hampton/Norfolk, Virginia area) will be for the purpose of familiarizing the test personnel with the procedures to be followed during actual testing.

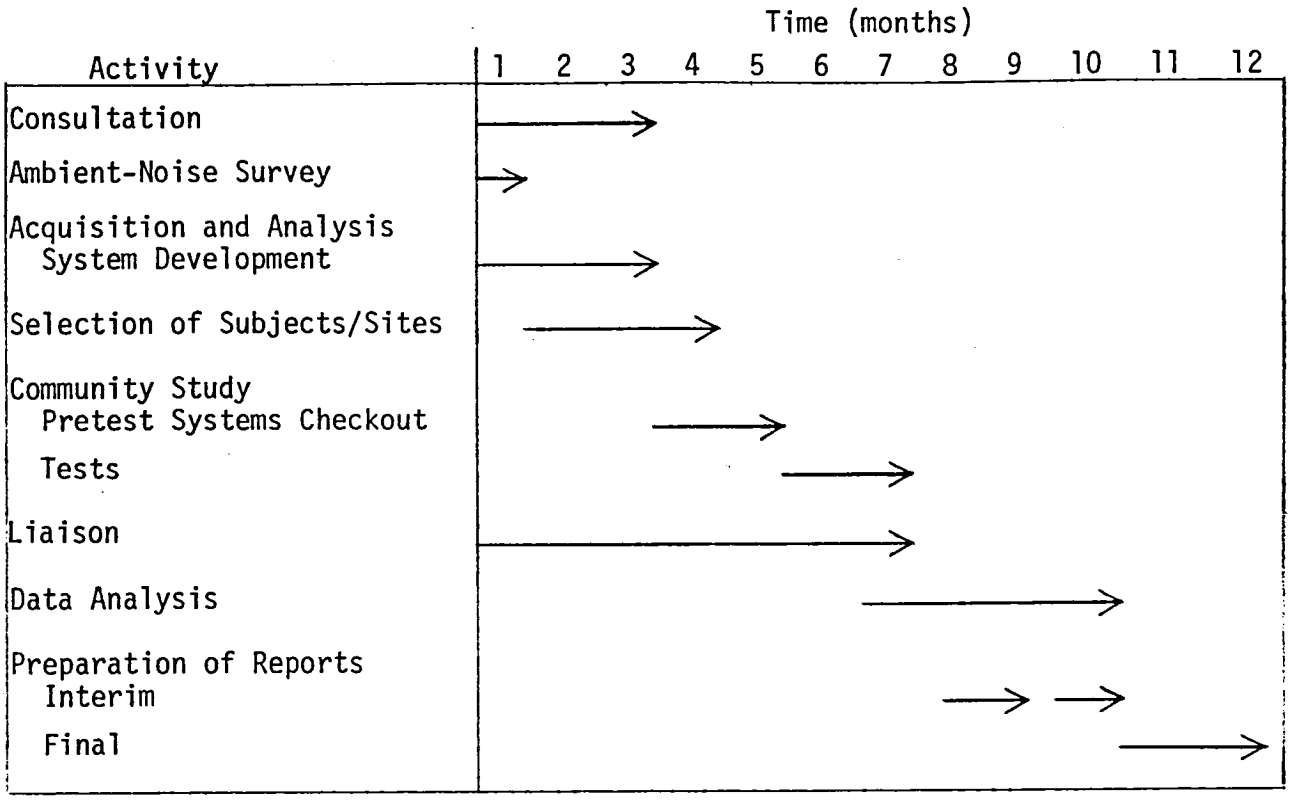
TABULATION AND PUBLICATION PLANS

The onsite data analysis system will expedite the analysis of what is expected to be a large data base. It is anticipated that several thousand subjective responses to individual aircraft flyover events will be recorded during this study, of which perhaps one-fourth will be analyzed in the field. The remainder of the data will be analyzed in about 10 to 12 weeks after the end of the acquisition activities and will be published in the public domain during this period in the form of NASA Technical Memorandums (progress reports). Results of the data analysis will be presented in the form of NASA Technical Papers, journal articles, and conference presentations following the data analysis period.

TIME SCHEDULE FOR DATA COLLECTION AND PUBLICATION

The time schedule for the entire project including the completion of reporting is shown on the "Project Schedule," Table III. The starting time for the schedule is partially dependent upon obtaining approval for the study from the OMB.

TABLE III.- PROJECT SCHEDULE



CONSULTATIONS OUTSIDE THE AGENCY

The proposed research program is part of an ongoing psychoacoustics program being conducted by and/or sponsored by the NASA Langley Research Center. The program is similar to recent laboratory and field studies directed at various aspects of aircraft noise. Thus, the majority of the conceptual and detailed planning was conducted by in-house personnel who have extensive training and experience in psychoacoustics, physical acoustics, and experimental design. As it has evolved, the planned program was presented to various technical organizations for critical review and feedback.

Presentations include:

- o September 26, 1979: The Noise Metrics Subcommittee of the SAE A-21 Aircraft Noise Committee. In attendance were representatives of the FAA, the EPA, aircraft industry, and airport/airline operators.
- o December 13-14, 1979: NASA Headquarters personnel and the Director of the FAA's Office of Environment and Energy (and staff).
- o March 11-12, 1980: Presented to participants of a noise workshop held at the NASA Langley Research Center. The purpose of the NASA/FAA sponsored workshop was to examine "Time-of-Day Corrections to Aircraft Noise Metrics" which is an issue embedded in the proposed study. Workshop participants included national and international experts in human response to noise, noise research, and policy/needs.

In addition, opinions were solicited from grantees and consultants on specific details during the design and it is anticipated that such consultations will continue during the course of the study. Close liaison has been maintained with representatives of the FAA's Office of Airports Programs and such liaison will continue until the end of the data acquisition phase of this project.

ESTIMATION OF RESPONDENT BURDEN

The maximum amount of time a respondent (and test site) is burdened is 2 hours. This period includes time for both physical equipment arrangement

and interactions with the participants. The interactions with participants are allotted the times shown in Table IV.

TABLE IV.- RESPONDENT ACTIVITIES

Time, min	Activity
25	Briefing/Debriefing
15	Instructions for Annoyance Responses to Aircraft Noise
60	Annoyance Responding to Aircraft Noise
20	Self-administered Questionnaire

Pretests have indicated that the time periods are sufficient to complete each task with ample time remaining for subject questions and comfort.

ESTIMATE OF COST TO FEDERAL GOVERNMENT

The total cost of this project will be shared by NASA and the FAA and is estimated to be $155,700. Through interagency agreement No. DOT-FA78WAI-874, Modification No. 3, the Federal Aviation Administration will supply a total of $100K for the project and the remainder will be paid by NASA. The breakdown of the total project cost is shown in Table V.

TABLE V.- TOTAL PROJECT COSTS

Expenditure Item	Man-hour	Cost
NASA Professional[1]	2000	$ 38,500
FAA Professional [1]	800	16,000
NASA Support Contractors	3080	46,200
Consultants (Including Survey Design)	500	15,000
Travel		10,000
Subject Pay		20,000
Equipment/Supplies		10,000
Total		$155,700

[1]FY 1980 R&D Base Funds.

The man-hours for the project will be divided according to the following table:

TABLE VI.- MAN-HOURS PER ACTIVITY

Activity	Hours
Consultants	500
Ambient Noise Survey	160
Acquisition and Analysis Development	250
Selection of Subjects/Sites	1200
Community Study	
Pretest	120
Test	3350
Liaison	100
Preparation of Reports	
Interim	250
Final	450
	6380

REFERENCES

1. The Noise Control Act of 1972 as amended by The Quiet Communities Act of 1978. United States Environmental Protection Agency, December 1978.

2. Aviation Safety and Noise Abatement Act of 1979. U. S. Public Law 96-193, Feb. 1980.

3. Schultz, Theodore J.: Synthesis of Social Surveys on Noise Annoyance. J. Acoustical Society of America, Vol. 64, No. 2, August 1978, pp. 377-405.

4. Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety. Environmental Protection Agency, EPA 550/9-74-004, 1974.

APPENDIX

INSTRUCTIONS READ TO TEST PARTICIPANTS

Introduction to Testing

The test for today consists of two parts:

(1) Annoyance evaluations of aircraft noises you hear today

and,

(2) Answering a short questionnaire

Administration of Informed Consent Form

Before we start, I would like you to read this form (distribute consent forms). Please date and sign the form to indicate you understand the form. (Collect consent forms)

Instructions for Annoyance Evaluations

Please read these instructions (hand out instructions) to yourself as I read them outloud.

Instructions for Questionnaire

Please answer these short questionnaires (hand out questionnaires). If you have difficulty with any questions, we will be glad to assist you.

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Experimental Consent Form

I understand that I will be asked questions and participate in experiments about the effects of aircraft noise on people. I understand that I may withdraw from these experiments at any time by a simple request to the investigators. I understand that although my name is recorded on the form, my name will be separated (permanently after 3 months) from the answers to insure complete confidentiality.

Information for residents:

General: The primary purpose for this investigation is to define a precise relationship(s) between subjective response and physical noise of an airport community. This information will lead to programs to optimize the reduction of aircraft noise through aircraft-airport operations, land-use planning, and aircraft design.

Routine statistical use of information:

Court proceedings.- In the event there is a pending court of formal administration proceedings, information may be disclosed to the Department of Justice or other agency for purposes of representing the Government, or in the course of presenting evidence, or they may be provided to parties or counsel involved in the proceeding in the course of pretrial discovery.

Other sources.- Information of this study will be disclosed to other individuals or organizations, including federal, state, or local agencies and nonprofit educational or private entities, who are participating in NASA programs or are otherwise furthering the understanding or application of the data. However, complete confidentiality of data sources is assured.

_____

(Signature)

_____

(Date)

ANNOYANCE EVALUATION INSTRUCTIONS

I would now like you to evaluate the amount of annoyance you associate with aircraft noises. At the end of an aircraft noise, you can evaluate the annoyance of the noise with your hand-held response panel. You push one button to indicate your annoyance for each aircraft noise.

- Push the "0" button if you are not annoyed at all.
- Push the "8" button if you are extremely annoyed.
- Push buttons between "0" and "8" to indicate amounts of annoyance between these two extremes.
- NOTE: Push the "0" button when you hear an aircraft noise, even if you are not annoyed.
- Each time a button is pushed, the number you pushed will appear in the upper panel window.

Before we start the test, push a couple of buttons for practice. Notice that you have to wait a couple of seconds before pushing the button for another aircraft.

ARE THERE ANY QUESTIONS?

Your cooperation in this survey is entirely voluntary. However, your cooperation is needed to make the results of this survey comprehensive, accurate, and timely.

QUESTIONNAIRE

ALL ANSWERS ARE CONFIDENTIAL

1. Age _____ 2. Sex _____ 3. Subject Number _____

4. What is your current home address:

_____
Number Street

_____
City State Zip Code

5. Do you own or rent your home: (Check ✓)

_____ OWN

_____ RENT

6. Compared to when you first moved into this home (for example, first month), has your annoyance to aircraft noise: (Check ✓)

_____ Increased?

_____ Decreased?

_____ Remained the same?

_____ Don't know.

7. How many miles (approximately) do you travel to work: _____

8. How many airplanes do you hear at work on a typical day? (Check ✓)

_____ None

_____ 5 to 10 noises

_____ Greater than 10

9. How many years have you lived at your current address? _____

If less than 10 years, go to question 10.

If more than 10 years, skip to question 13.

10. What was your previous address:

_____
Number Street

_____
City State Zip Code

11. How many years did you live at your previous address? _____

12. Was your previous address within 10 miles of an airport? (Check ✓)

_____ Yes

_____ No

13. Do you or a member of your family <u>now</u> work for: (Check ✓, one or more)

_____ An airport

_____ An airline company

_____ An aviation industry

_____ Military aviation

_____ None of the above

_____ Other: Specify _____

14. <u>In the past</u>, did you or a member of your family work for: (Check ✓, one or more)

_____ An airport

_____ An airline company

_____ An aviation industry

_____ Military aviation

_____ None of the above

_____ Other: Specify _____

15. Do you or a member of your family have a pilot's license? (Check ✓)

_____ Yes

_____ No

16. Indicate your annoyance to commercial jet noise (Circle).

NOT ANNOYED AT ALL	0	1	2	3	4	5	6	7	8	EXTREMELY ANNOYED

17. Indicate your annoyance to helicopter noise (Circle).

NOT ANNOYED AT ALL	0	1	2	3	4	5	6	7	8	EXTREMELY ANNOYED

18. Indicate your annoyance to small, propeller-driven airplane noise (Circle).

NOT ANNOYED AT ALL	0	1	2	3	4	5	6	7	8	EXTREMELY ANNOYED

19. Indicate your overall annoyance to airplane noise of your neighborhood (Circle).

NOT ANNOYED AT ALL	0	1	2	3	4	5	6	7	8	EXTREMELY ANNOYED

20. Please circle the number along the scale that you would use to describe yourself as "highly annoyed." (Circle)

NOT ANNOYED AT ALL	0	1	2	3	4	5	6	7	8	EXTREMELY ANNOYED

21. Indicate the days of the week that you normally work away from home. (Circle)

NONE MON TUES WED THURS FRI SAT SUN

22. Indicate with checkmarks (✓) typical times of workdays you are:

		HOME			SLEEPING	
	TIME OF DAY	YES	NO	TIME OF DAY	YES	NO
Morning	7 a.m.			7 a.m.		
	8 a.m.			8 a.m.		
	9 a.m.			9 a.m.		
	10 a.m.			10 a.m.		
	11 a.m.			11 a.m.		
	12 noon			12 noon		
Afternoon	1 p.m.			1 p.m.		
	2 p.m.			2 p.m.		
	3 p.m.			3 p.m.		
	4 p.m.			4 p.m.		
	5 p.m.			5 p.m.		
	6 p.m.			6 p.m.		
Evening	7 p.m.			7 p.m.		
	8 p.m.			8 p.m.		
	9 p.m.			9 p.m.		
	10 p.m.			10 p.m.		
	11 p.m.			11 p.m.		
	12 p.m.			12 p.m.		
Late Night	1 a.m.			1 a.m.		
	2 a.m.			2 a.m.		
	3 a.m.			3 a.m.		
	4 a.m.			4 a.m.		
	5 a.m.			5 a.m.		
	6 a.m.			6 a.m.		

23. Indicate with checkmarks (✓) typical times of <u>nonworkdays</u> you are:

	HOME			SLEEPING		
	TIME OF DAY	YES	NO	TIME OF DAY	YES	NO
Morning	7 a.m.			7 a.m.		
	8 a.m.			8 a.m.		
	9 a.m.			9 a.m.		
	10 a.m.			10 a.m.		
	11 a.m.			11 a.m.		
	12 noon			12 noon		
Afternoon	1 p.m.			1 p.m.		
	2 p.m.			2 p.m.		
	3 p.m.			3 p.m.		
	4 p.m.			4 p.m.		
	5 p.m.			5 p.m.		
	6 p.m.			6 p.m.		
Evening	7 p.m.			7 p.m.		
	8 p.m.			8 p.m.		
	9 p.m.			9 p.m.		
	10 p.m.			10 p.m.		
	11 p.m.			11 p.m.		
	12 p.m.			12 p.m.		
Late Night	1 a.m.			1 a.m.		
	2 a.m.			2 a.m.		
	3 a.m.			3 a.m.		
	4 a.m.			4 a.m.		
	5 a.m.			5 a.m.		
	6 a.m.			6 a.m.		

24. Indicate your annoyance to aircraft noise at different times of a workday. (Circle number)

		NOT ANNOYED AT ALL								EXTREMELY ANNOYED
Morning	7 a.m.	0	1	2	3	4	5	6	7	8
	8 a.m.	0	1	2	3	4	5	6	7	8
	9 a.m.	0	1	2	3	4	5	6	7	8
	10 a.m.	0	1	2	3	4	5	6	7	8
	11 a.m.	0	1	2	3	4	5	6	7	8
	12 noon	0	1	2	3	4	5	6	7	8
Afternoon	1 p.m.	0	1	2	3	4	5	6	7	8
	2 p.m.	0	1	2	3	4	5	6	7	8
	3 p.m.	0	1	2	3	4	5	6	7	8
	4 p.m.	0	1	2	3	4	5	6	7	8
	5 p.m.	0	1	2	3	4	5	6	7	8
	6 p.m.	0	1	2	3	4	5	6	7	8
Evening	7 p.m.	0	1	2	3	4	5	6	7	8
	8 p.m.	0	1	2	3	4	5	6	7	8
	9 p.m.	0	1	2	3	4	5	6	7	8
	10 p.m.	0	1	2	3	4	5	6	7	8
	11 p.m.	0	1	2	3	4	5	6	7	8
	12 p.m.	0	1	2	3	4	5	6	7	8
Late Night	1 a.m.	0	1	2	3	4	5	6	7	8
	2 a.m.	0	1	2	3	4	5	6	7	8
	3 a.m.	0	1	2	3	4	5	6	7	8
	4 a.m.	0	1	2	3	4	5	6	7	8
	5 a.m.	0	1	2	3	4	5	6	7	8
	6 a.m.	0	1	2	3	4	5	6	7	8

25. Indicate your annoyance to aircraft noise at different times of nonworkdays. (Circle number)

		NOT ANNOYED AT ALL								EXTREMELY ANNOYED
Morning	7 a.m.	0	1	2	3	4	5	6	7	8
	8 a.m.	0	1	2	3	4	5	6	7	8
	9 a.m.	0	1	2	3	4	5	6	7	8
	10 a.m.	0	1	2	3	4	5	6	7	8
	11 a.m.	0	1	2	3	4	5	6	7	8
	12 noon	0	1	2	3	4	5	6	7	8
Afternoon	1 p.m.	0	1	2	3	4	5	6	7	8
	2 p.m.	0	1	2	3	4	5	6	7	8
	3 p.m.	0	1	2	3	4	5	6	7	8
	4 p.m.	0	1	2	3	4	5	6	7	8
	5 p.m.	0	1	2	3	4	5	6	7	8
	6 p.m.	0	1	2	3	4	5	6	7	8
Evening	7 p.m.	0	1	2	3	4	5	6	7	8
	8 p.m.	0	1	2	3	4	5	6	7	8
	9 p.m.	0	1	2	3	4	5	6	7	8
	10 p.m.	0	1	2	3	4	5	6	7	8
	11 p.m.	0	1	2	3	4	5	6	7	8
	12 p.m.	0	1	2	3	4	5	6	7	8
Late Night	1 a.m.	0	1	2	3	4	5	6	7	8
	2 a.m.	0	1	2	3	4	5	6	7	8
	3 a.m.	0	1	2	3	4	5	6	7	8
	4 a.m.	0	1	2	3	4	5	6	7	8
	5 a.m.	0	1	2	3	4	5	6	7	8
	6 a.m.	0	1	2	3	4	5	6	7	8

26. Imagine that an airplane has just flown over your house which is loud enough for you to become "highly annoyed" with the noise. How long after such a flyover do you think you would typically remain "highly annoyed?" (Check (✓) one)

_____ less than 5 minutes
_____ 5 to 15 minutes
_____ 15 minutes to 1 hour
_____ 1 hour to 6 hours
_____ 6 hours to 12 hours
_____ 12 hours to 24 hours
_____ more than 24 hours

27. Would your answer to the last question be different for flyovers occurring at different time of the day? (Check ✓)

_____ Yes
_____ No

If "yes" answer question 28. If "no" go to question 29.

28. If YES, how long after a highly annoying flyover would you remain "highly annoyed" if the flyover occurred in the:

Morning (7 a.m. - noon) _____
Afternoon (1 p.m. - 6 p.m.) _____
Evening (7 p.m. - 12 p.m.) _____
Late Night (1 a.m. - 6 a.m.) _____

29. Imagine that you live near an airport which is willing to alternate its active runways to reduce airport noise in your neighborhood. The airport will direct flights away from your neighborhood for a fixed period of time and then will allow flights over your neighborhood for the same period of time. For example, the airport might prohibit flights over your neighborhood for 1 hour and then allow flights for the next hour alternating in this way through the day. If you could select the length of these on and off periods, what length of time would you select? (Indicate by checkmarks (✓))

_____ no preference
_____ on 1 hour, off 1 hour
_____ on 2 hours, off 2 hours
_____ on 3 hours, off 3 hours
_____ on 4 hours, off 4 hours
_____ on 5 hours, off 5 hours
_____ on 6 hours, off 6 hours
_____ on 7 hours, off 7 hours
_____ on 8 hours, off 8 hours
_____ on 9 hours, off 9 hours
_____ on 10 hours, off 10 hours
_____ on 11 hours, off 11 hours
_____ on 12 hours, off 12 hours

30. Would your answer to question no. 29 be different for different times of day? (Check ✓)

_____ Yes

_____ No

If "no" this is the end of the testing. If "yes" go to question 31.

31. If YES, what on/off period would you prefer in the

Morning (7 a.m. - noon) _____
Afternoon (1 p.m. - 6 p.m.) _____
Evening (7 p.m. - 12 p.m.) _____
Late Night (1 a.m. - 6 a.m.) _____

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15. Supplementary Notes

16. Abstract

This report provides the study plan for a joint NASA/FAA study to quantify human response to aircraft noise. The objective of this study is to quantify the relationship between human annoyance and the noise level of individual aircraft events, and as a corollary, to assess the validity of various noise descriptors or noise metrics for quantifying aircraft noise levels.

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